

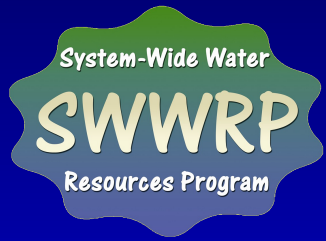
Upper Mississippi River Floodplain Inundation Mapping

Charles Theiling – MVR Environmental
Branch

John Burant – MVR Hydrology & Hydraulics
Branch **Robert Wallace** – ERDC System-
Wide Water

Resources Program

**Presentation to:
Planning Community of Practice
San Antonio, TX
20-22 May 2008**



USACE Need for Floodplain Inundation Mapping

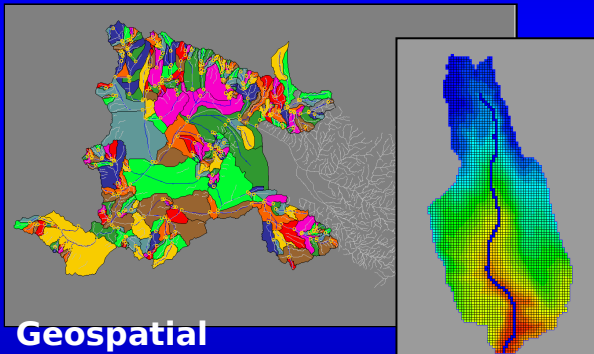
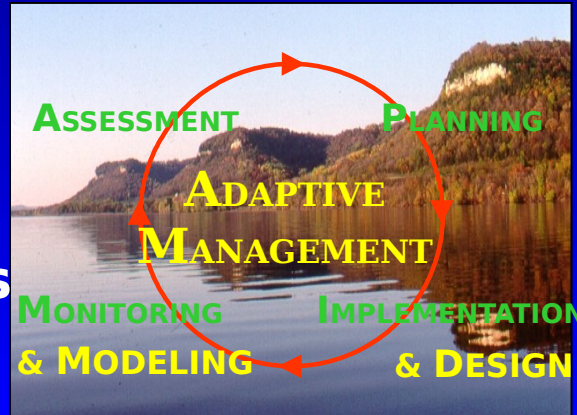
- **Flood Protection**
- **Hazard Assessment**
- **Ecosystem Restoration**

First two are traditional applications; The last can benefit from information produced by the former.

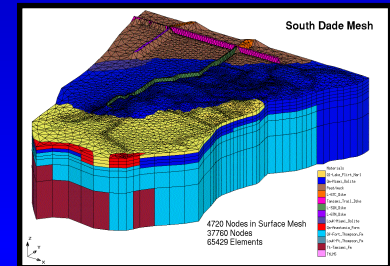
One team: Relevant, Ready, Responsive and Reliable

Adaptive Ecosystem Management

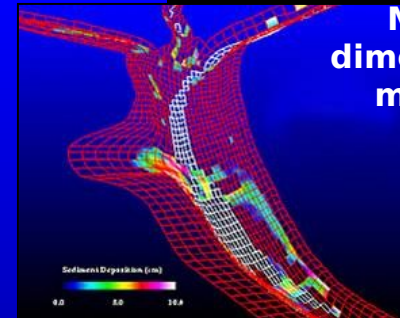
SWWRP
Right Tool - Right Problem
Integrating Programs



Geospatial Assessments

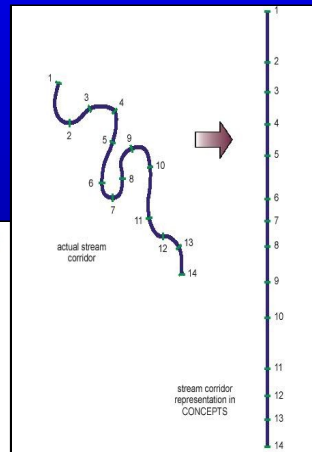
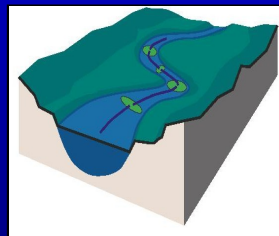


Multi-dimensional models



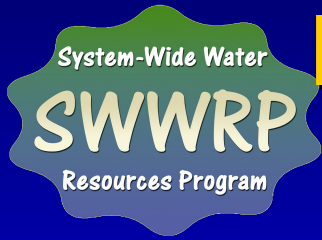
Model to Model Integration

Data to Model Integration



1-D river models

One Team: Relevant, Ready, Responsive and Reliable



Prior UMRS Floodplain Inundation Mapping



- **Traditional Flood Protection Analysis**
 - Stage frequency analysis
 - Flood risk/damage assessment
- **Great Flood of 1993**
 - Scientific Assessment and Strategy Team
 - Comprehensive 4-ft. elevation maps
- **UMRS Flow Frequency Study (2004)**
 - Stage frequency re-evaluation after Flood of Record in 1993
- **UMRS Comp Plan (2006) modeled system-wide flood profiles for alternative flood protection levels, including no levee alternative**

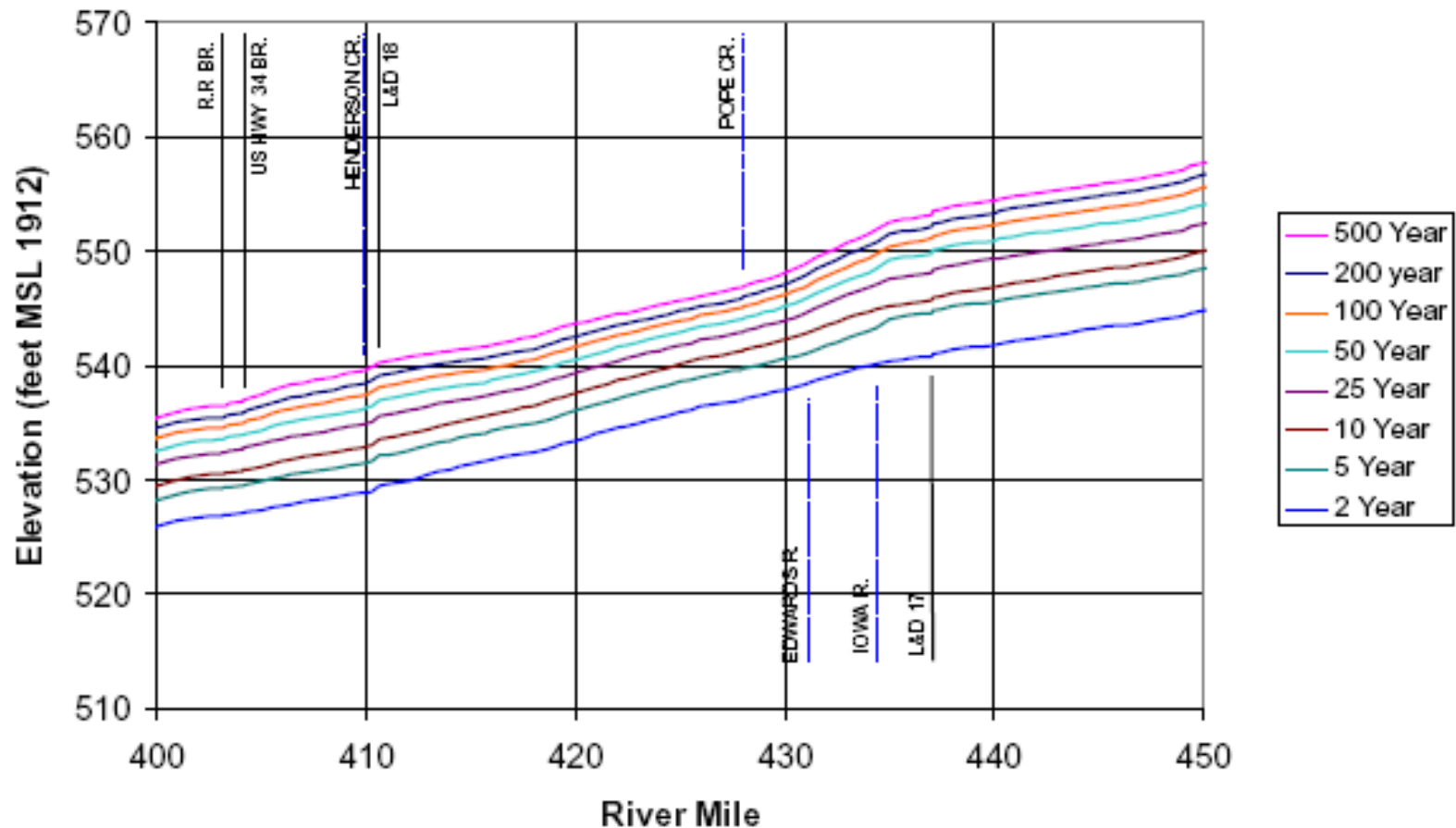
One team: Relevant, Ready, Responsive and Reliable

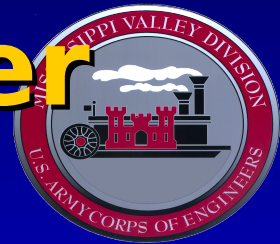


Flow Frequency Study

- **Water surface elevation associated with each frequency discharge at each location or cross section along the river reach.**
- **Connecting the corresponding points resulted in flood frequency profiles.**

2003 Mississippi River Stage Frequency Profiles



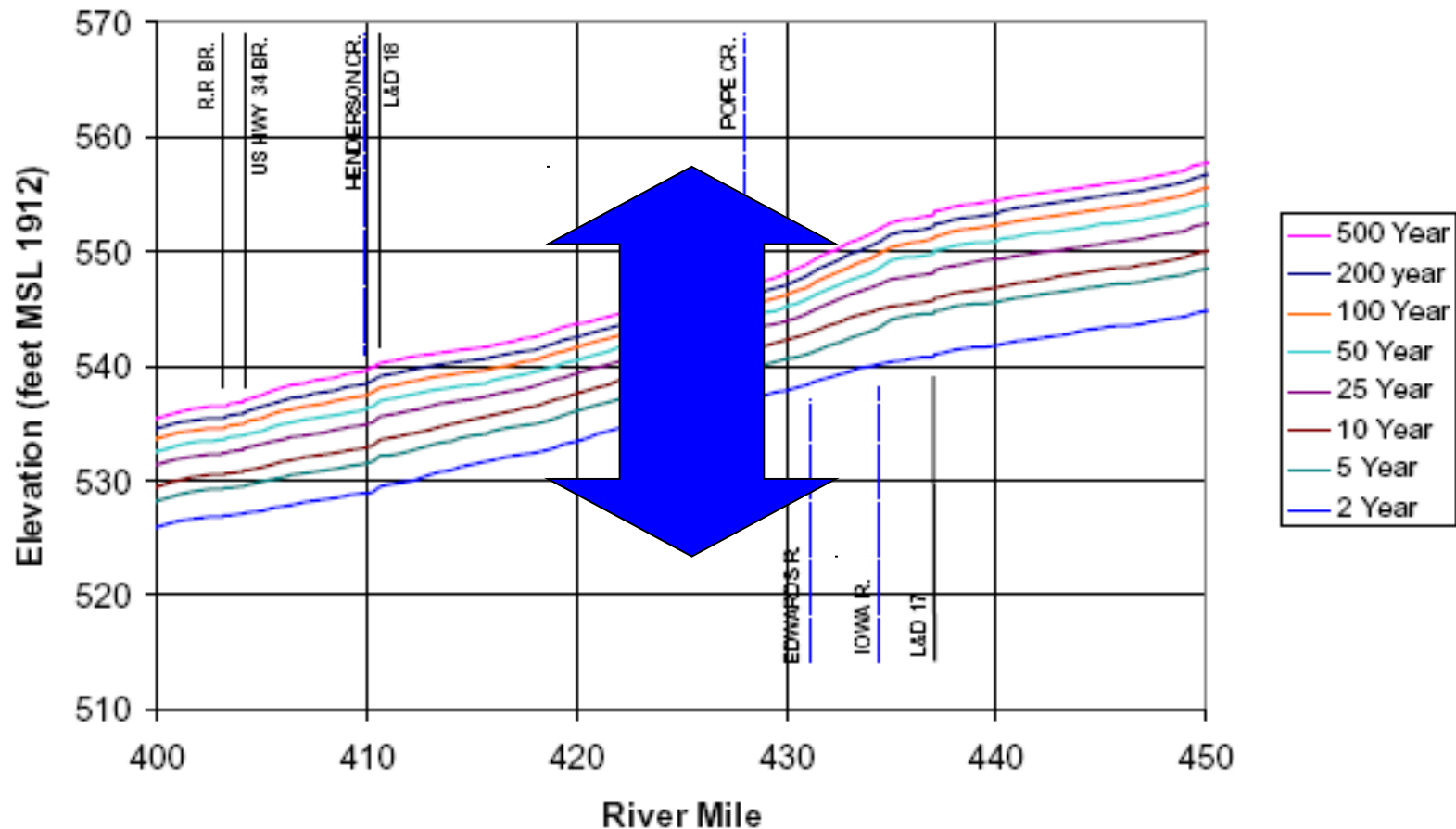


Upper Mississippi River Comprehensive Plan Hydrologic Analysis

Comparing the computed stage frequency from each alternative simulation with that of an existing condition simulation (i.e., Flow Frequency Study) provides the stage impacts for each alternative.

Produce a final frequency water surface elevation to be used in computing economic flood damages and construction costs for each alternative.

2003 Mississippi River Stage Frequency Profiles





Upper Mississippi River Comprehensive Plan Hydrologic Analysis

Comparing the computed stage frequency from each alternative simulation with that of an existing condition simulation (i.e., Flow Frequency Study) provides the stage impacts for each alternative.

Produce a final frequency water surface elevation to be used in computing economic flood damages and construction costs for each

**Not every alternative can be applied to
ER benefit assessment!**



Building on the Past for Ecosystem Restoration Assessment

- **Floodplain inundation mapping for ecosystem restoration alternative analysis**
 - **Google Earth Application**
 - **Historic analysis of Upper Peoria backwaters**
 - **Google Earth Demo (if possible)**

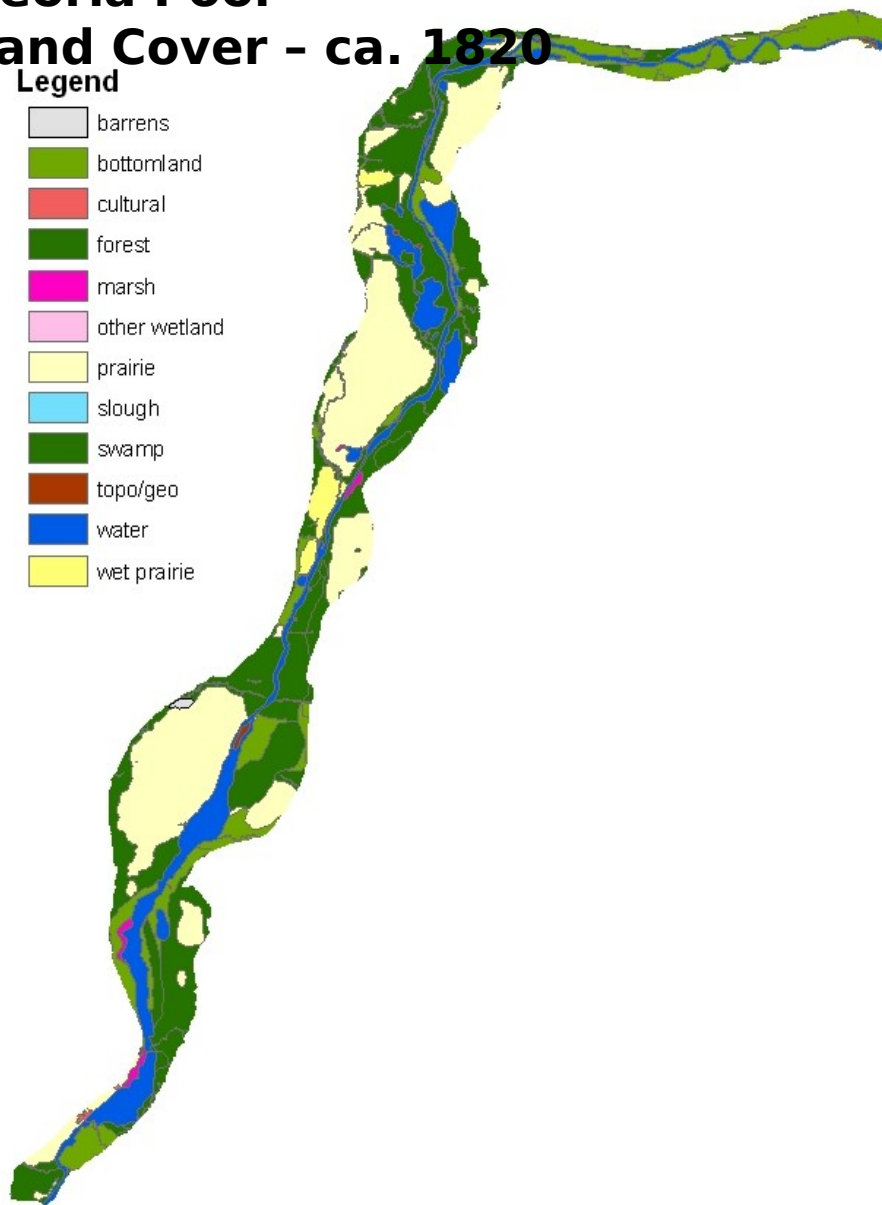
The Problem: Impoundment Effect

Peoria Pool

Land Cover - ca. 1820

Legend

- barrens
- bottomland
- cultural
- forest
- marsh
- other wetland
- prairie
- slough
- swamp
- topo/geo
- water
- wet prairie



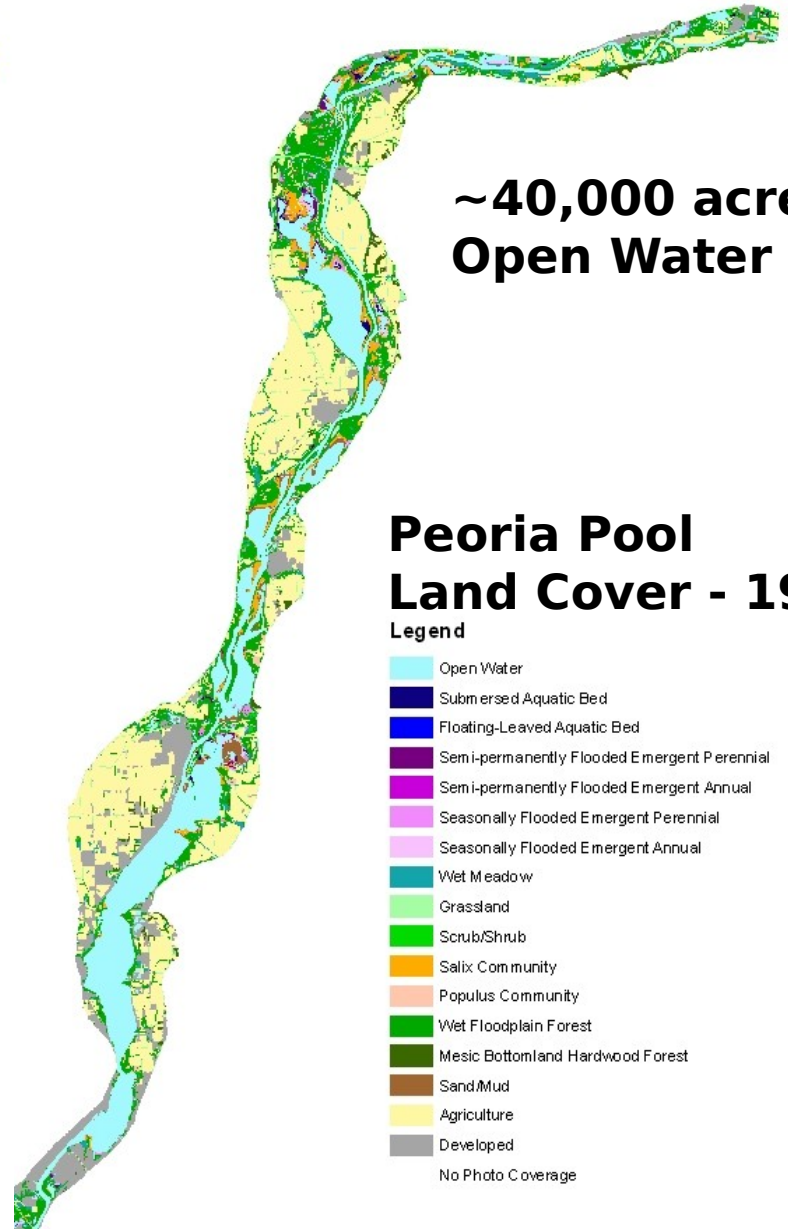
**~40,000 acres
Open Water**

Peoria Pool

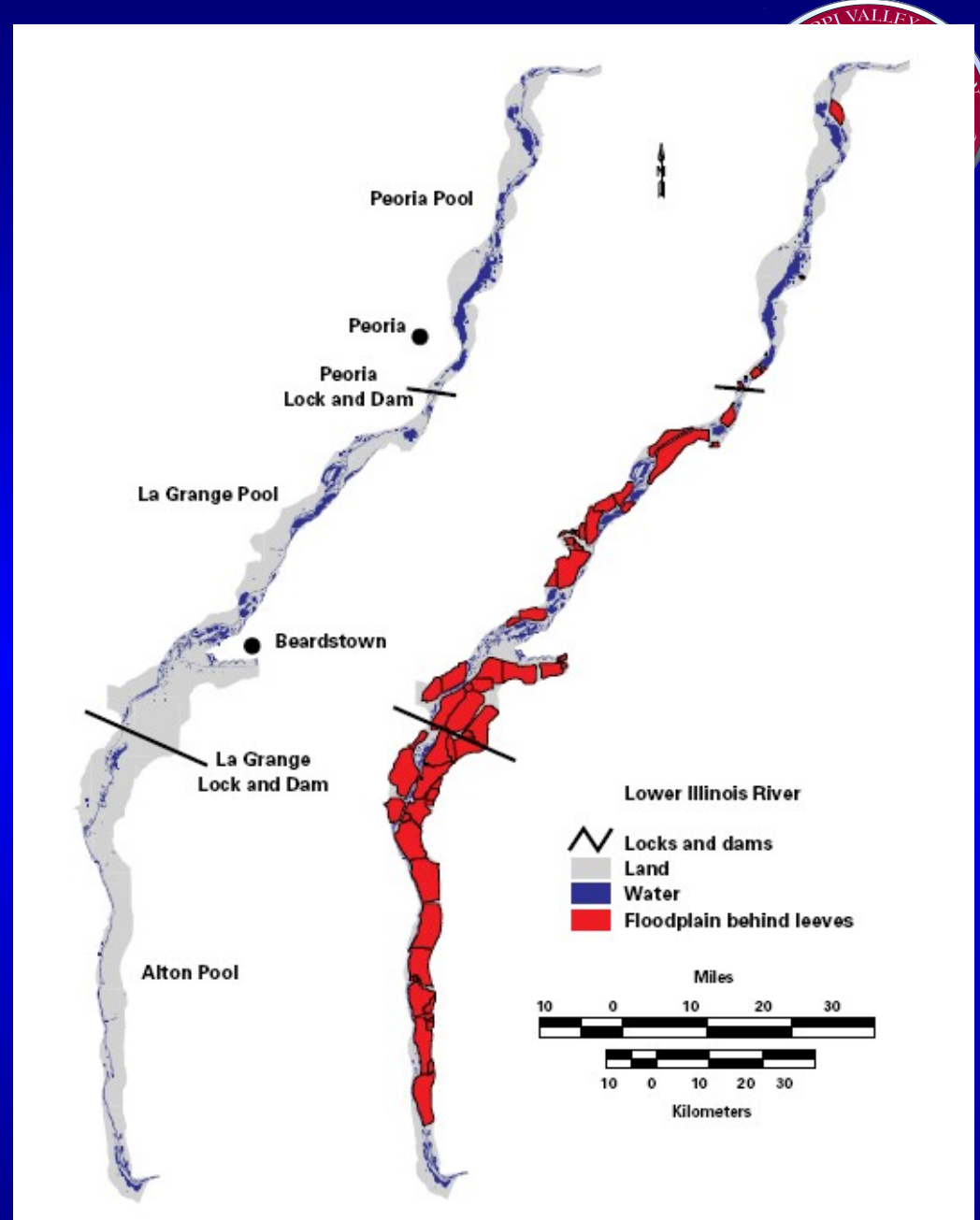
Land Cover - 1989

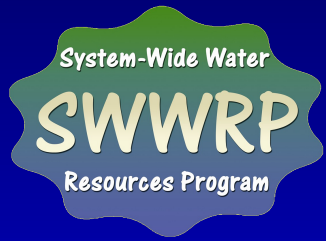
Legend

- Open Water
- Submersed Aquatic Bed
- Floating-Leaved Aquatic Bed
- Semi-permanently Flooded Emergent Perennial
- Semi-permanently Flooded Emergent Annual
- Seasonally Flooded Emergent Perennial
- Seasonally Flooded Emergent Annual
- Wet Meadow
- Grassland
- Scrub/Shrub
- Salix Community
- Populus Community
- Wet Floodplain Forest
- Mesic Bottomland Hardwood Forest
- Sand/Mud
- Agriculture
- Developed
- No Photo Coverage



The Problem: Levee Effects





Levee Impact Analysis



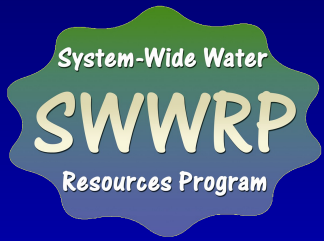
Pool 18

Existing Condition - Controlled Pool Stage

Land Cover

- Open Water
- Submersed Aquatic Bed
- Floating-Leaved Aquatic Bed
- Semi-permanently Flooded Emergent Perennial
- Semi-permanently Flooded Emergent Annual
- Seasonally Flooded Emergent Perennial
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- Agriculture
- Developed
- No Photo Coverage

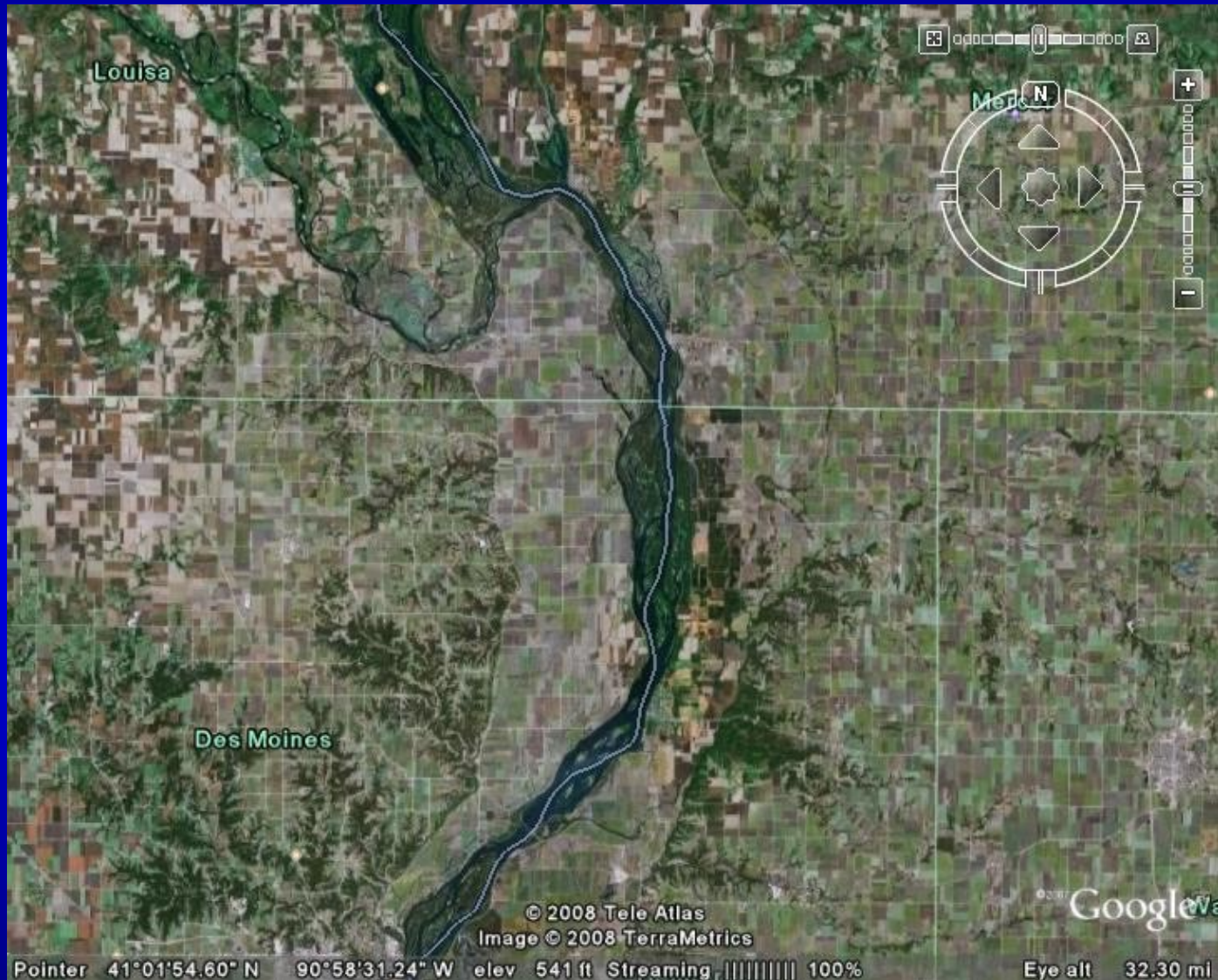




Pool 18 Existing Condition - Leveed Area

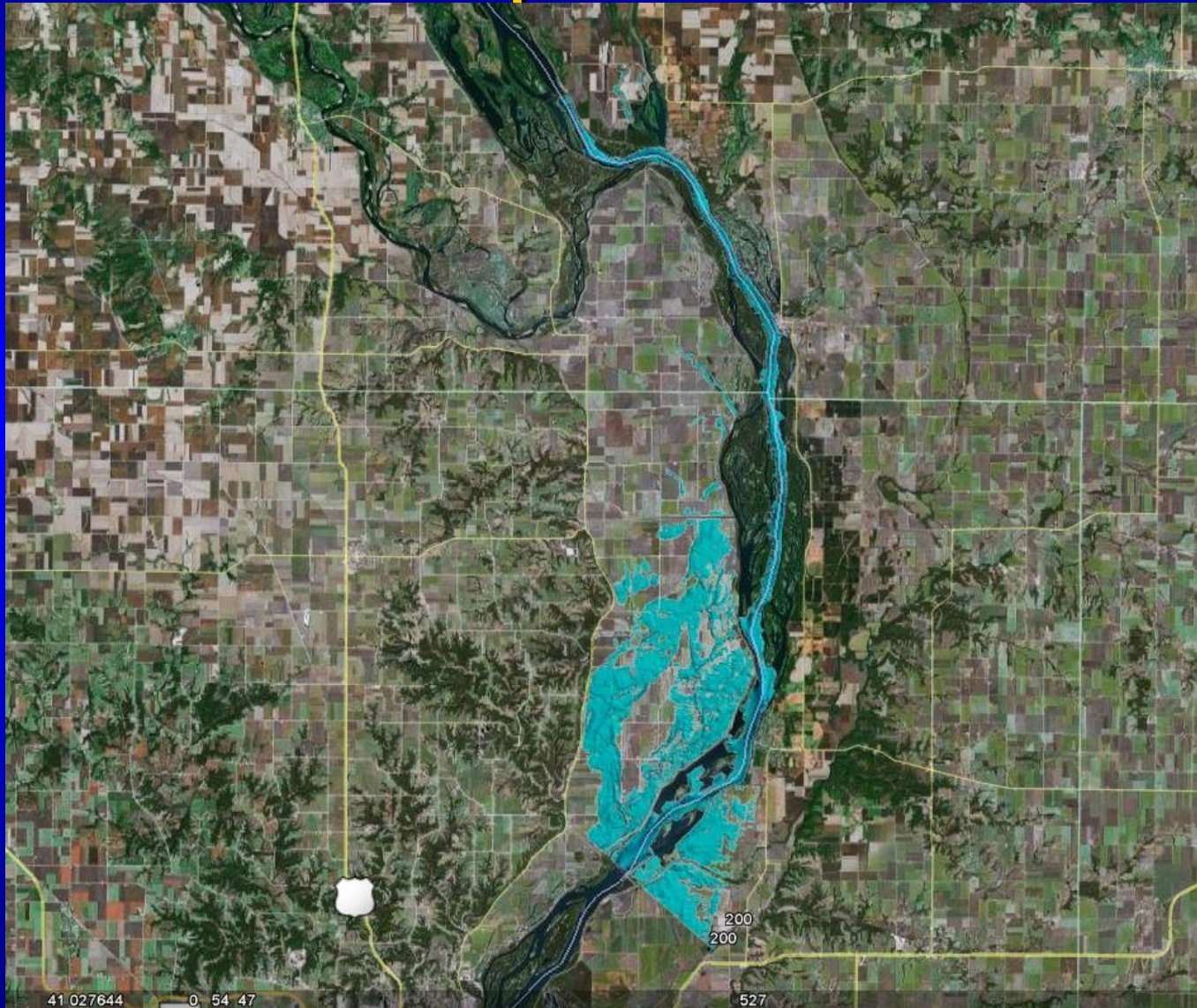


Controlled Pool

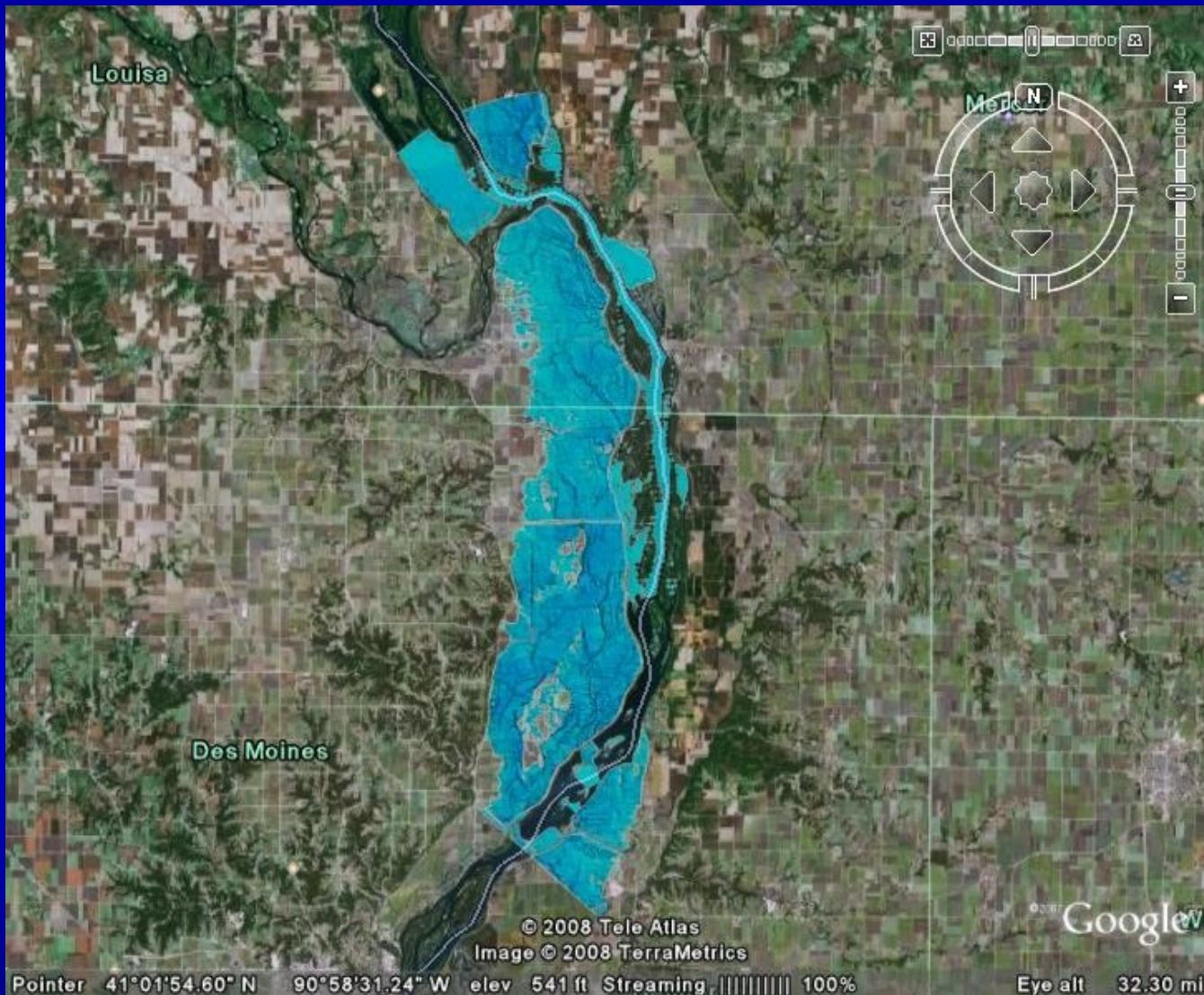
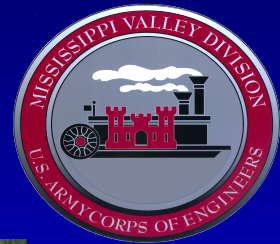


One Team: Relevant, Ready, Responsive and Reliable

Pumps turned off, controlled pool

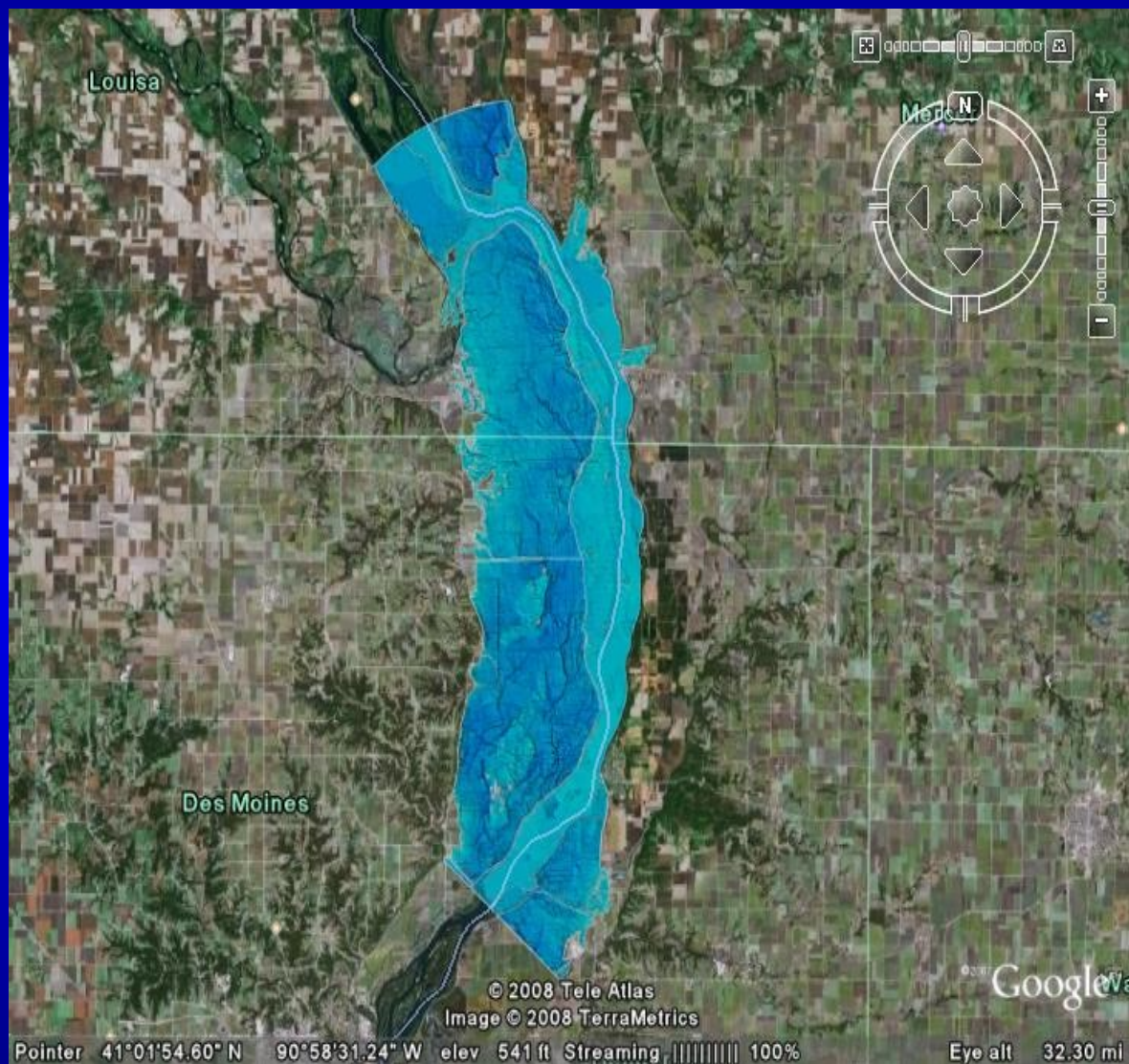


2-yr Flood, No Levee



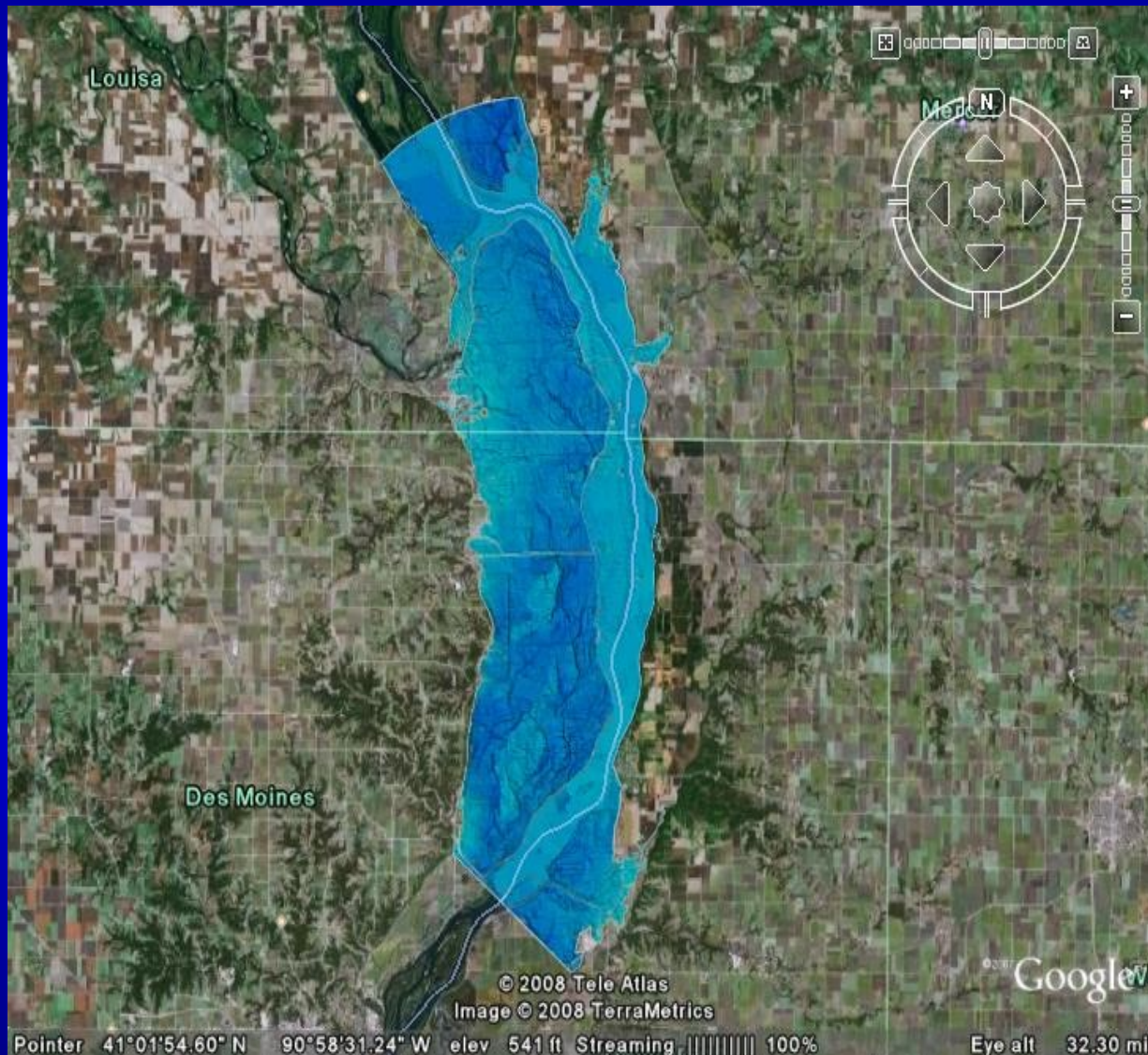
One Team: Relevant, Ready, Responsive and Reliable

10-yr Flood, No Levee

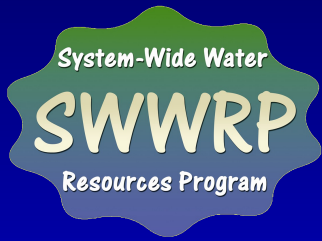


One Team: Relevant, Ready, Responsive and Reliable

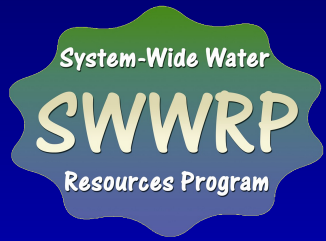
50 yr flood, no levee



One Team: Relevant, Ready, Responsive and Reliable



- **Provides rapid imaging of floodplain restoration alternatives in a common web-based interface**
- **Increase communication with non-technical audience**
- **Still need to convert to acres through GIS layering**
- **Have for entire UMRS**
- **Will develop SOP for interns & technicians**

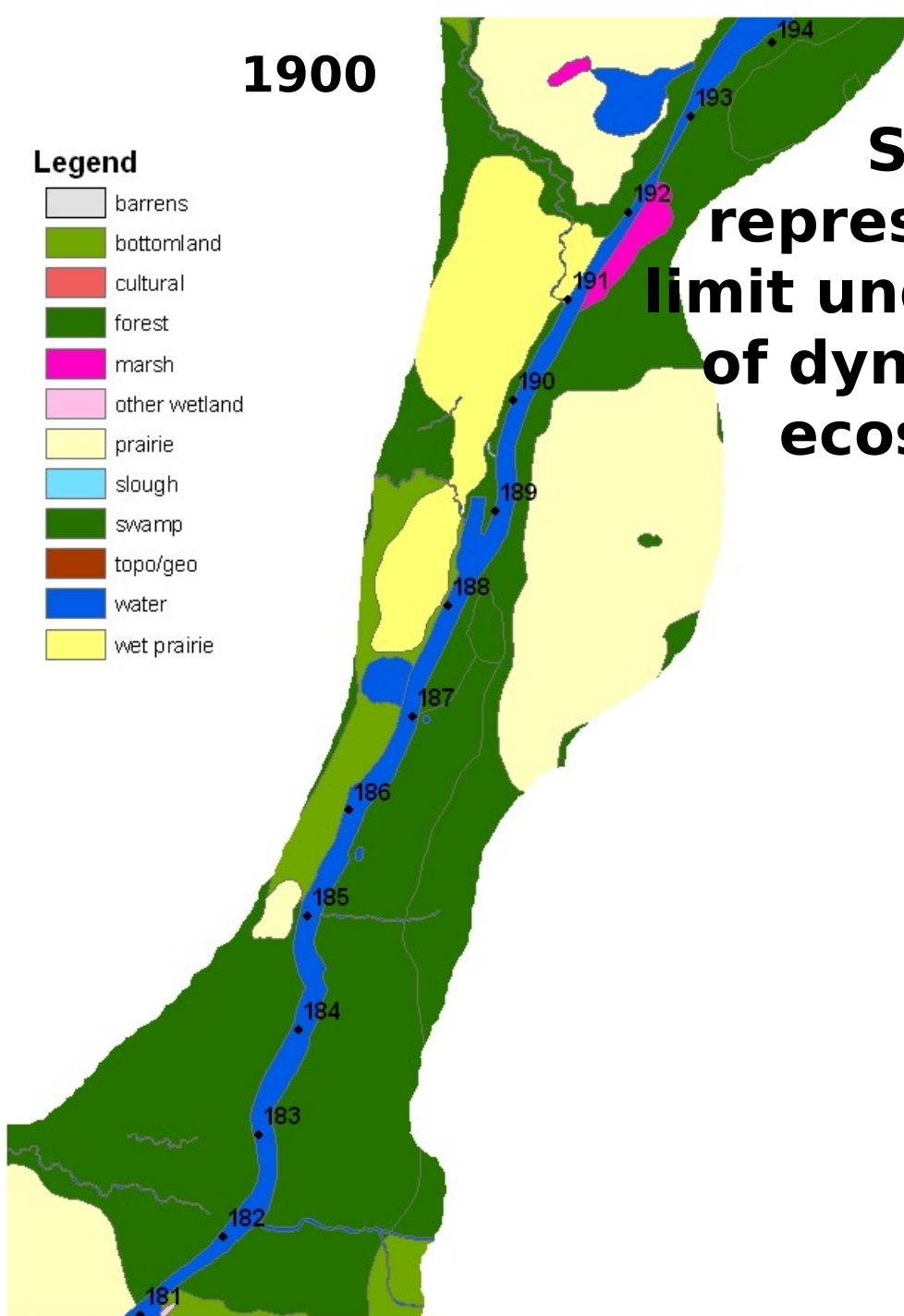


Impoundment Effects Analysis

1900

Legend

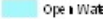
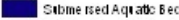
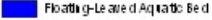
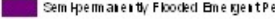
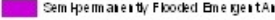
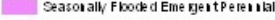
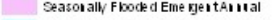
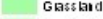
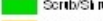
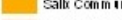
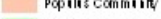
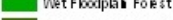
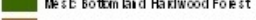
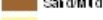
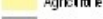
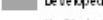
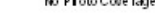
-  barrens
-  bottomland
-  cultural
-  forest
-  marsh
-  other wetland
-  prairie
-  slough
-  swamp
-  topo/geo
-  water
-  wet prairie

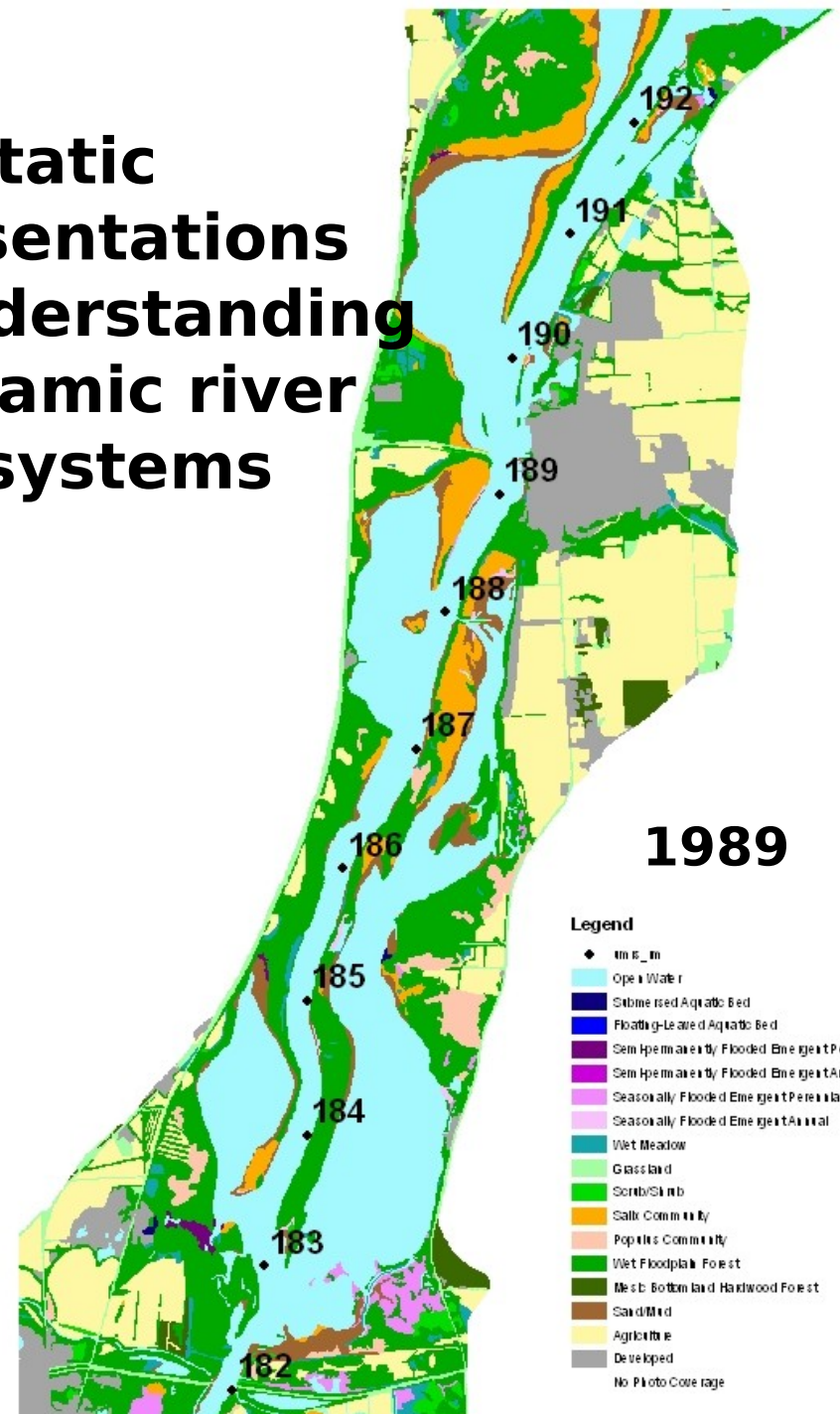


**Static
representations
limit understanding
of dynamic river
ecosystems**

1989

Legend

-  point
-  Open Water
-  Submersed Aquatic Bed
-  Floating-Leaved Aquatic Bed
-  Semi-permanently Flooded Emergent Perennial
-  Semi-permanently Flooded Emergent Annual
-  Seasonally Flooded Emergent Perennial
-  Seasonally Flooded Emergent Annual
-  Wet Meadow
-  Grassland
-  Scrub/Shrub
-  Salt Community
-  Populus Community
-  Wet Floodplain Forest
-  Mesic Bottomland Hardwood Forest
-  Sand/Mud
-  Agriculture
-  Developed
-  No Photo Coverage



1903 Historical Conditions

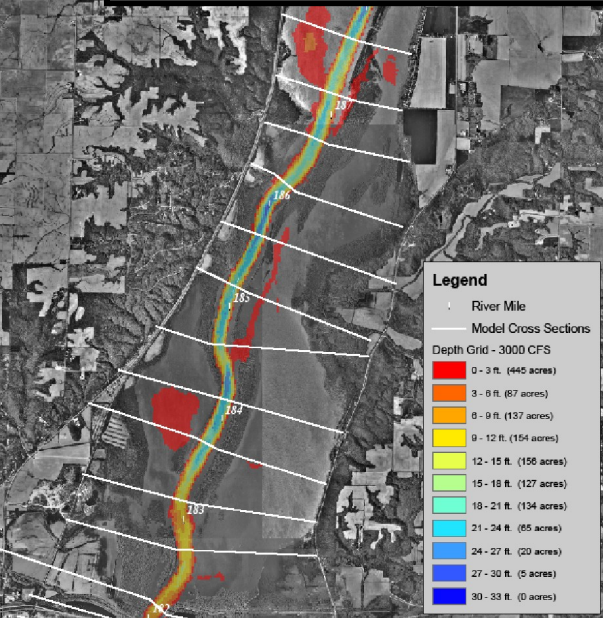
Middle Peoria Pool

Computed Depth Grid from 1903-Condition HEC-RAS Model
Middle Peoria Pool

Computed Depth Grid from 1903-Condition HEC-RAS Model
Middle Peoria Pool

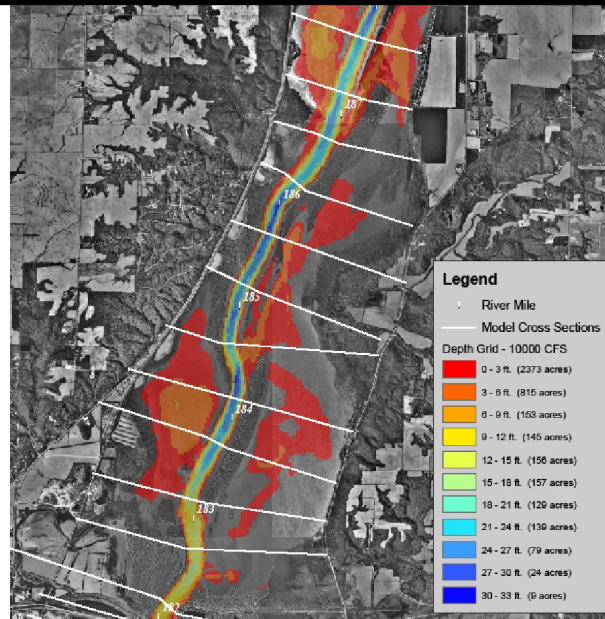
Computed Depth Grid from 1903-Condition HEC-RAS Model
Middle Peoria Pool

Not quite dynamic, but can bracket range of variation



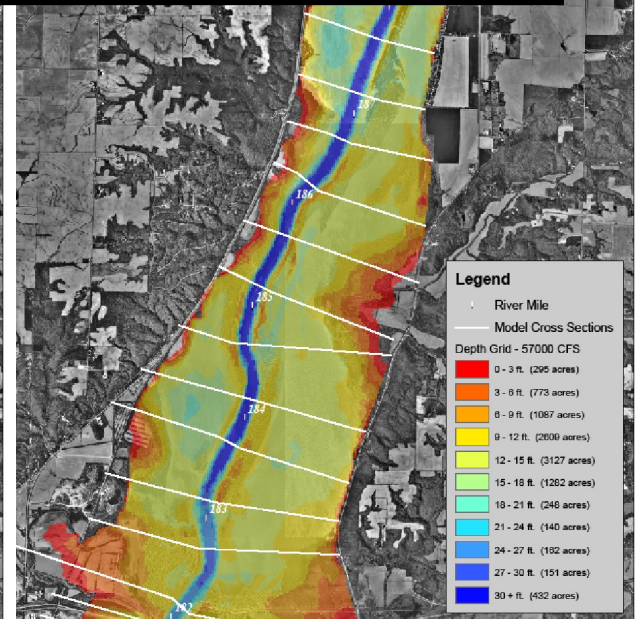
5-14-2007

3,000 cfs



5-14-2007

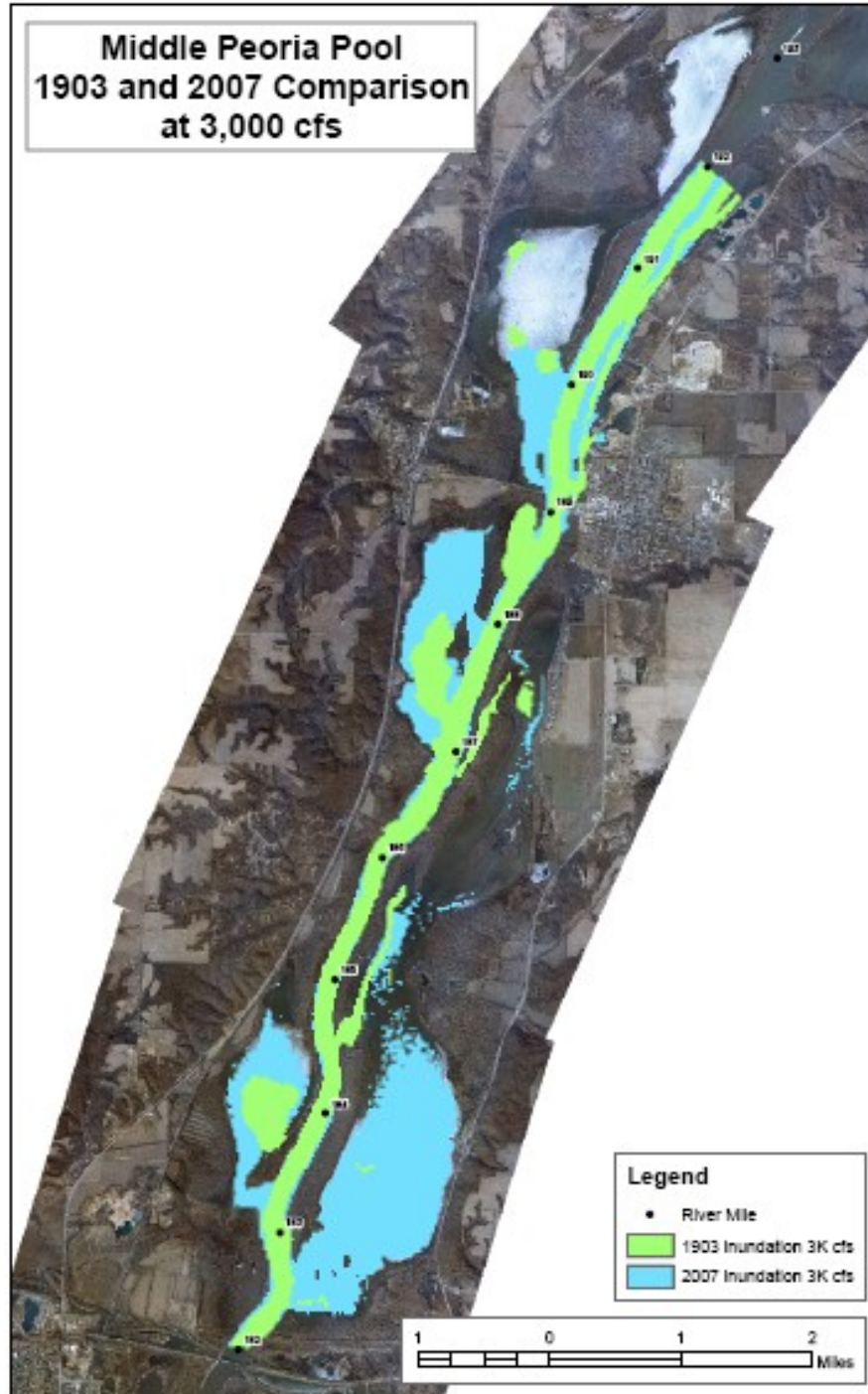
10,000 cfs

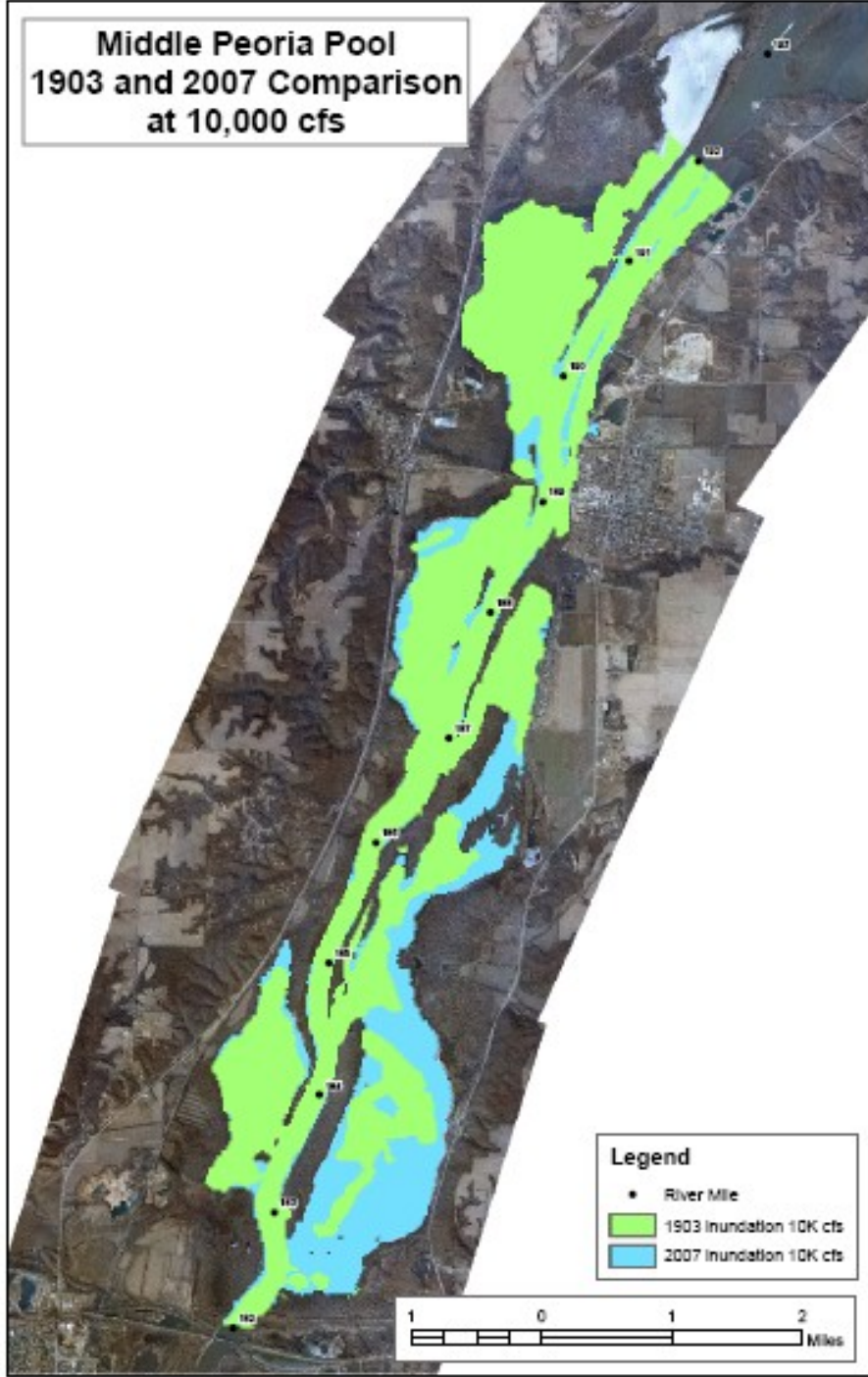


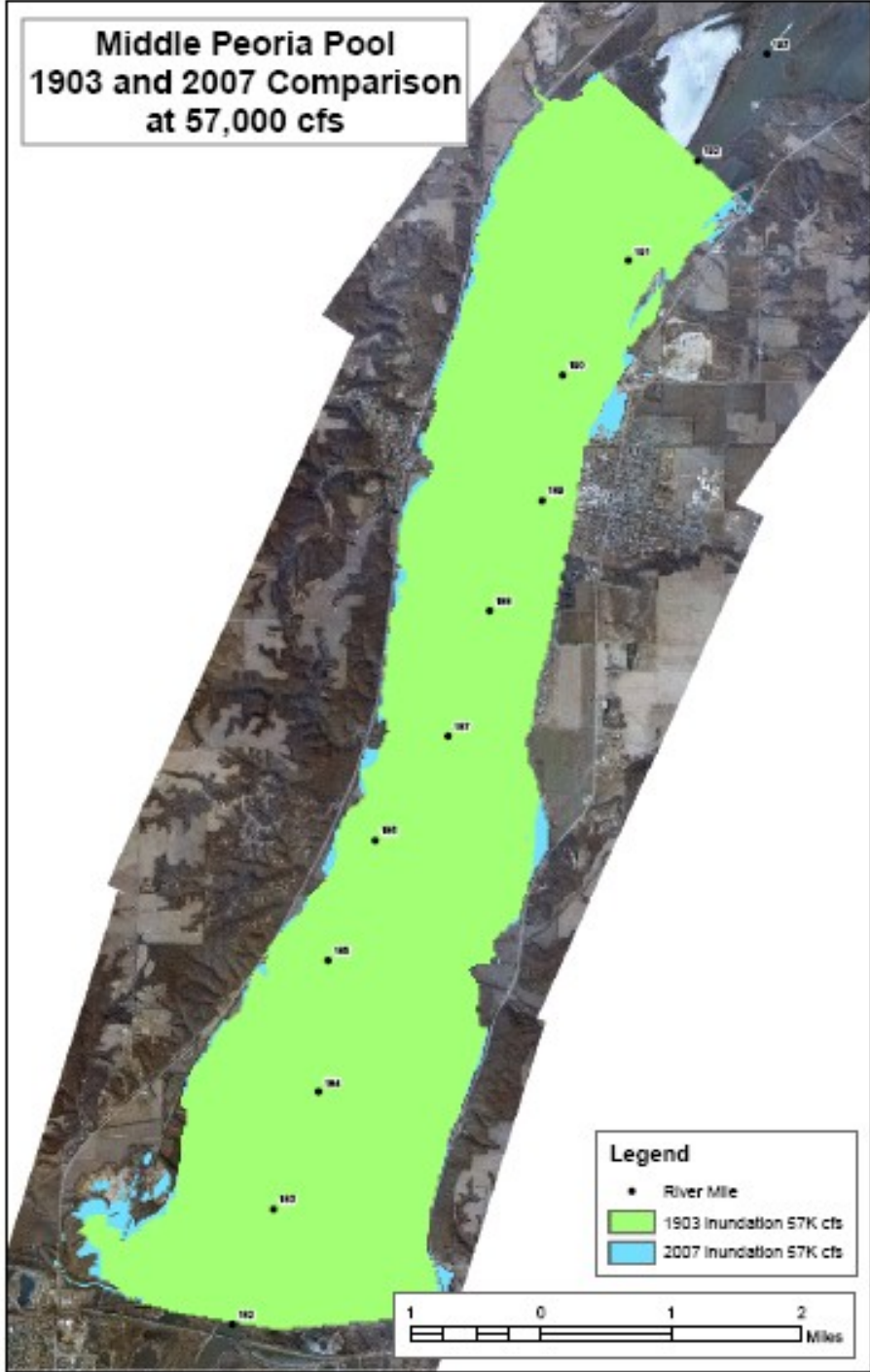
5-14-2007

57,000 cfs

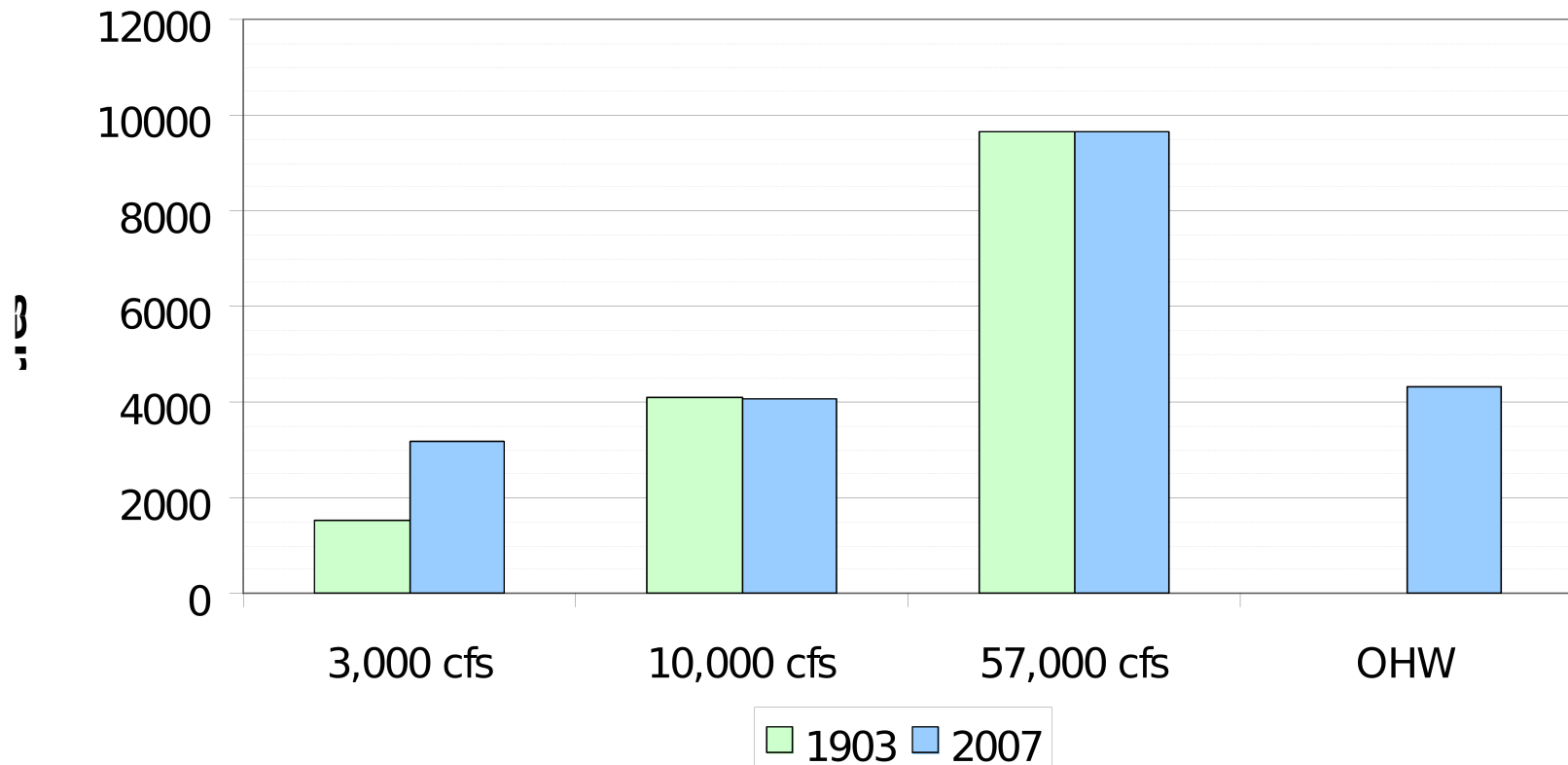
Middle Peoria Pool
1903 and 2007 Comparison
at 3,000 cfs







Middle Peoria Pool Areas Inundated

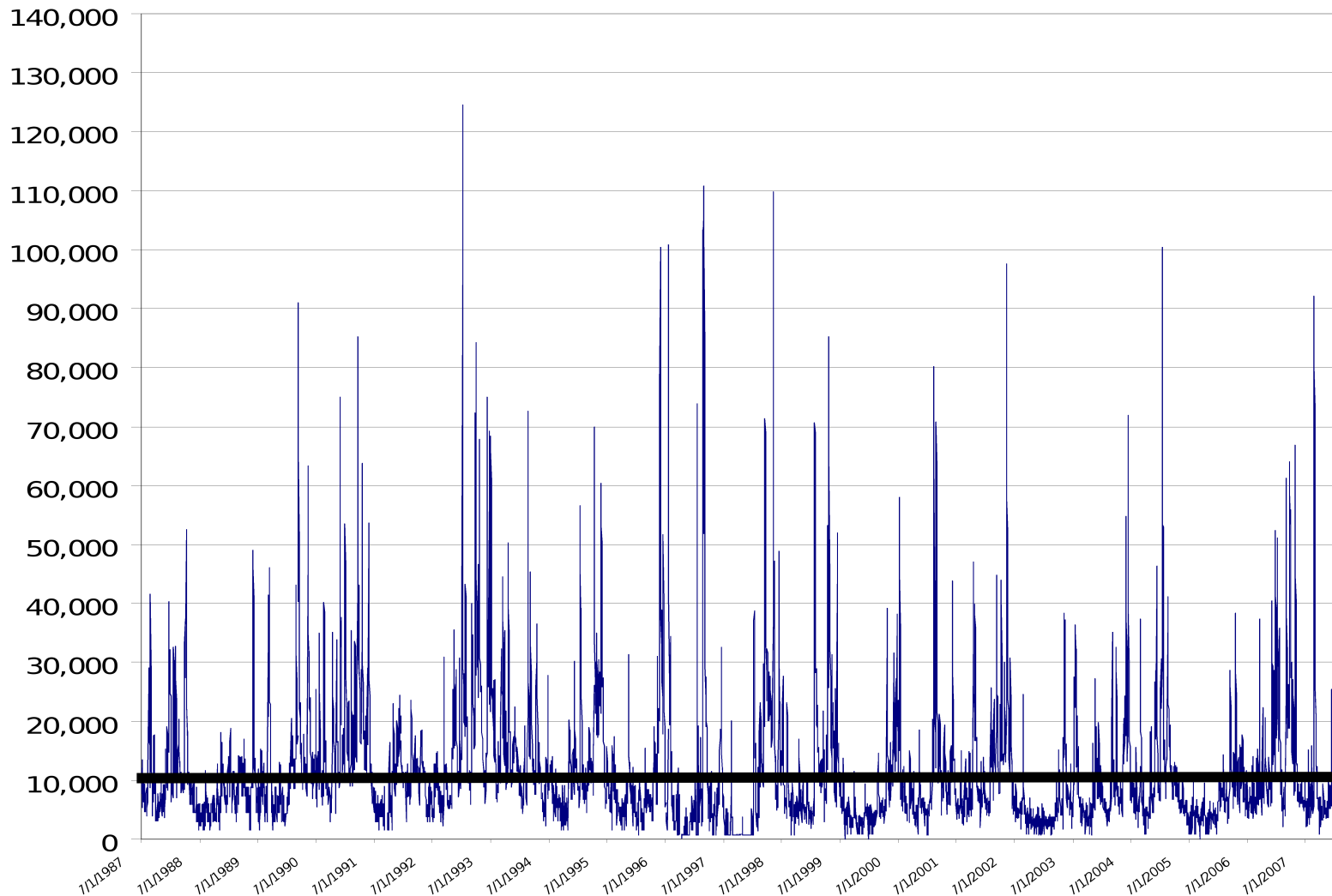


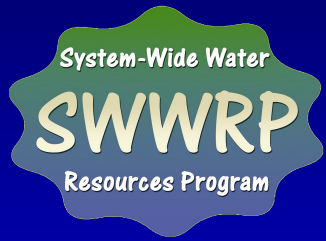


The River is Frequently Below 10,000 cfs.



Starved Rock Discharge



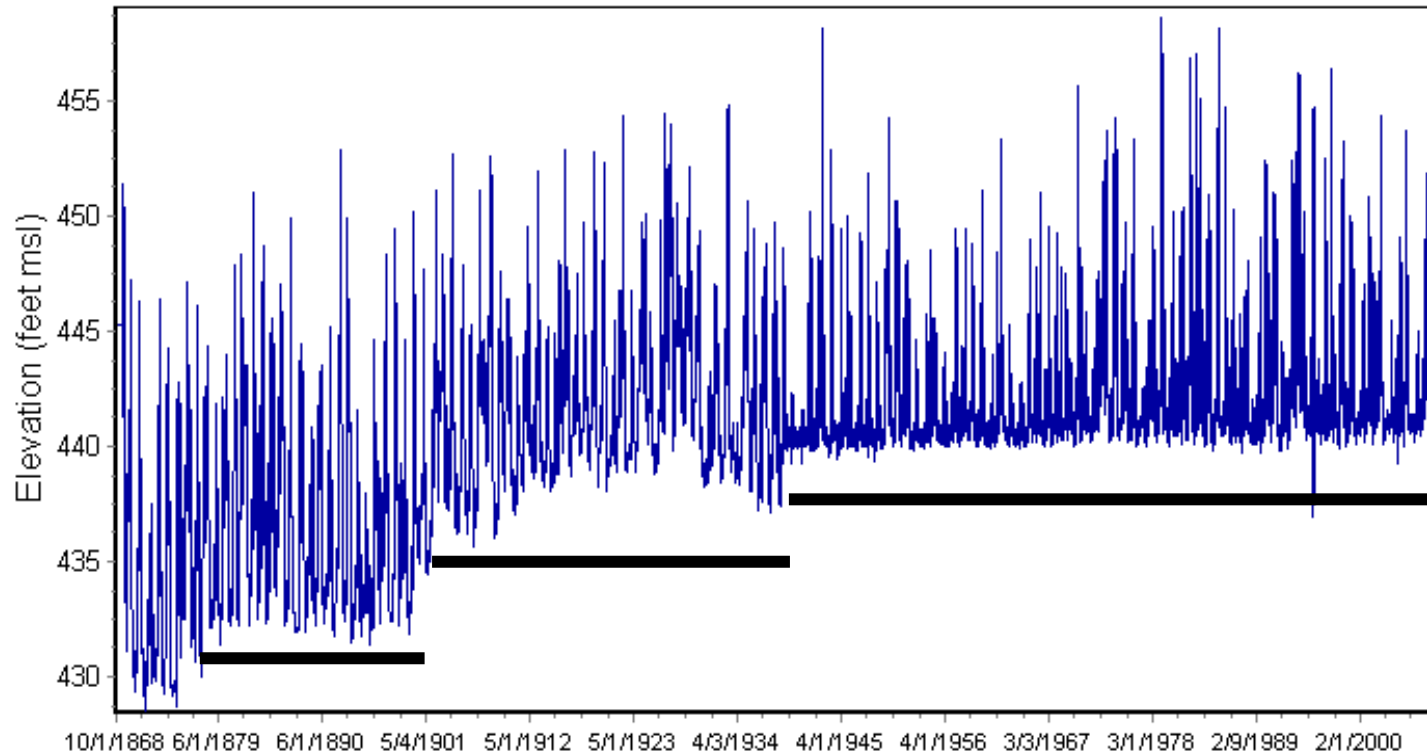


We continue development an index of the spatial-temporal characteristics of floodplain inundation to estimate benefits of floodplain restoration.

Can Compare Multiple Reference Conditions



Henry Illinois, Upper Peoria Pool
Daily Data (1869-2008)



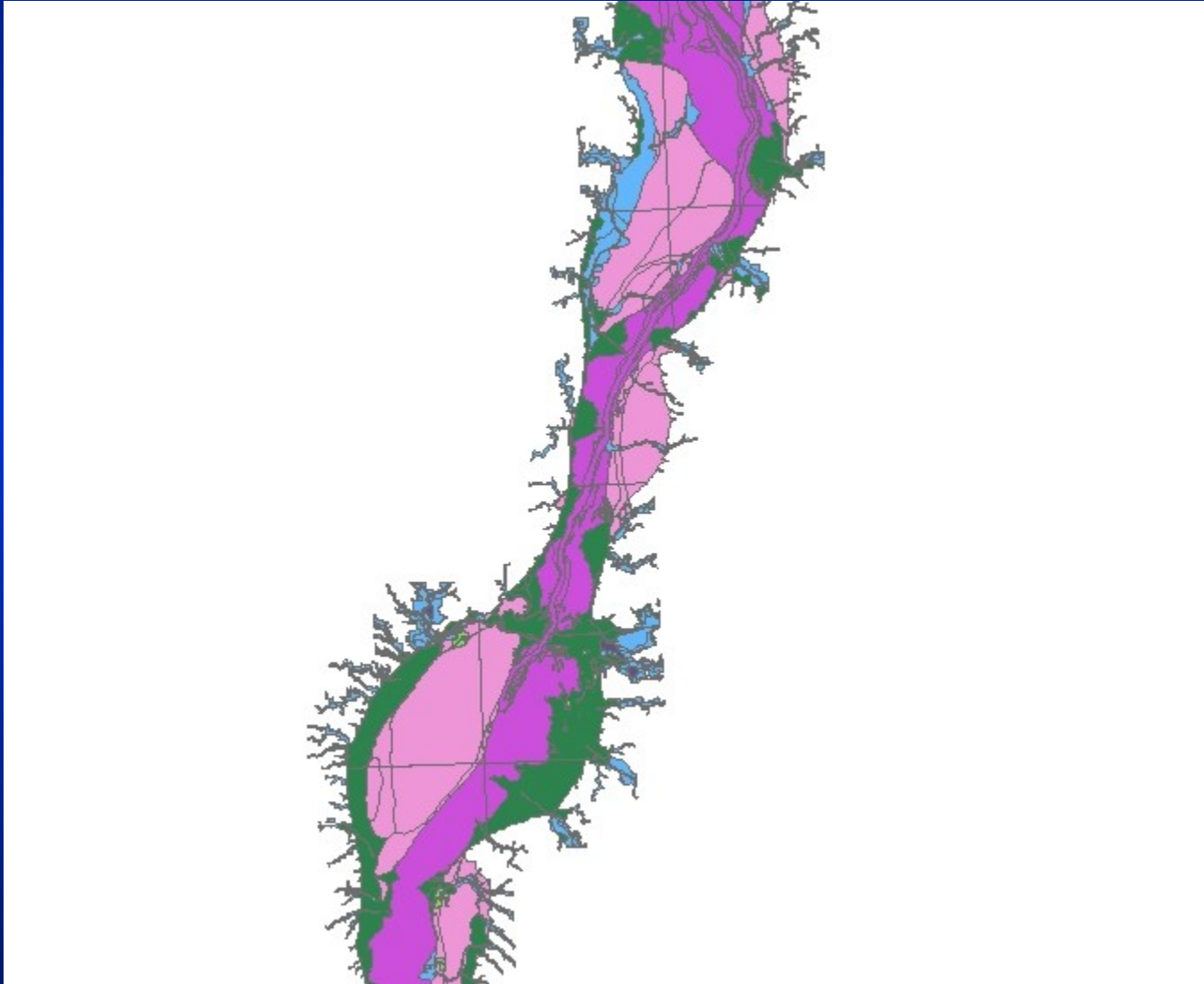
**I&M Chicago
Canal S&S Canal**

Peoria Dam

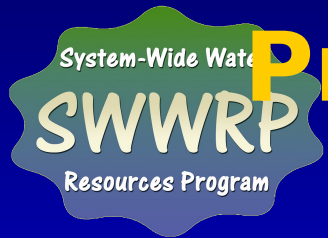
One Team: Relevant, Ready, Responsive and Reliable



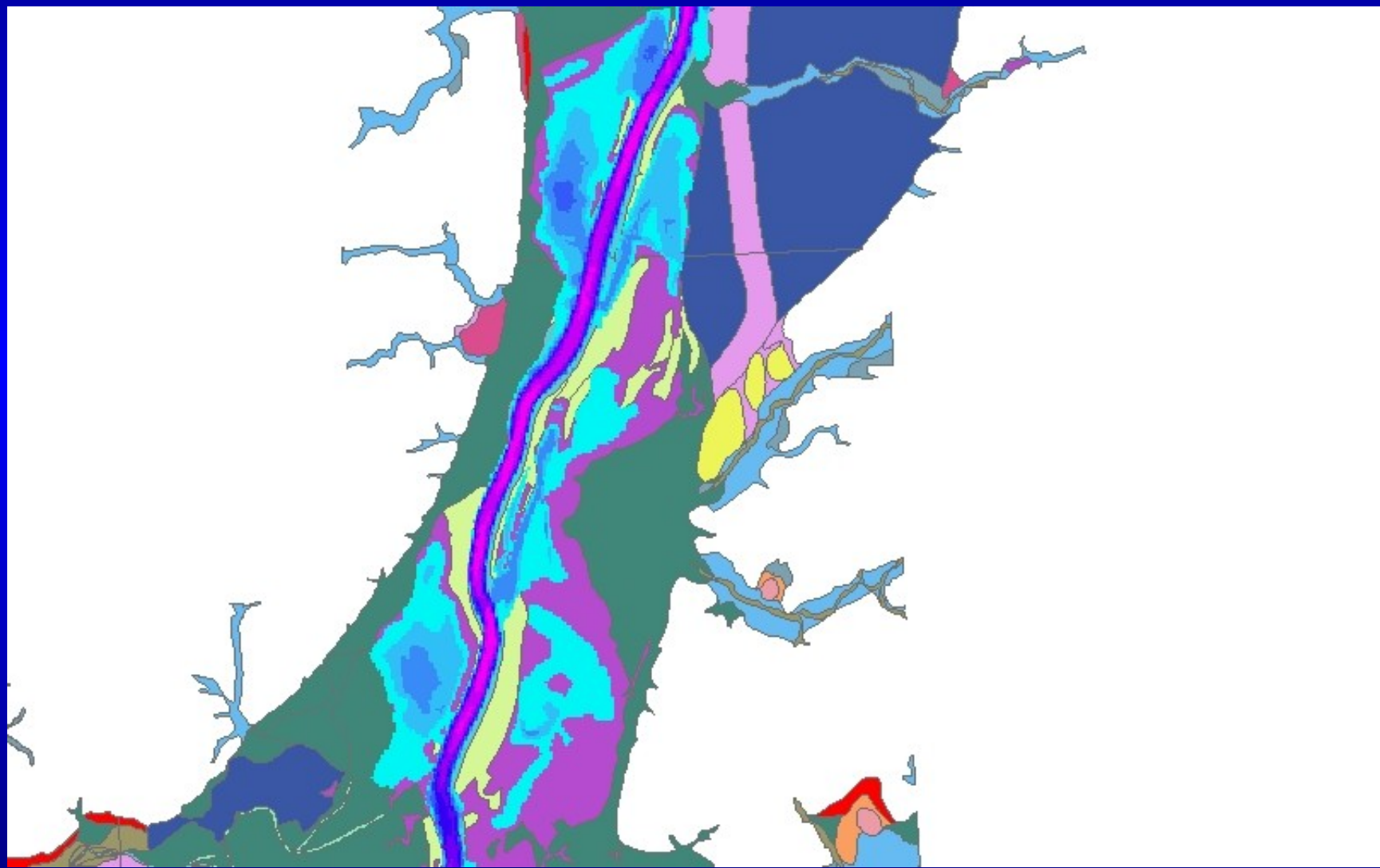
Predictive Habitat Models Geomorphology Layer



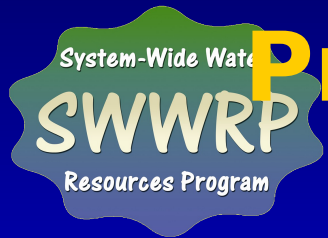
One Team: Relevant, Ready, Responsive and Reliable



Predictive Habitat Models Hydrology Layer



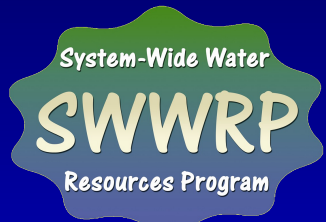
One Team: Relevant, Ready, Responsive and Reliable



Predictive Habitat Models Land Cover Layer



One Team: Relevant, Ready, Responsive and Reliable



UMRS Adaptive Ecosystem Management

- **Opportunities to integrate across Corps programs and disciplines**
- **Opportunities to Improve Ecosystem Restoration Benefit Assessment**
- **Opportunities to understand ecosystem process and function**